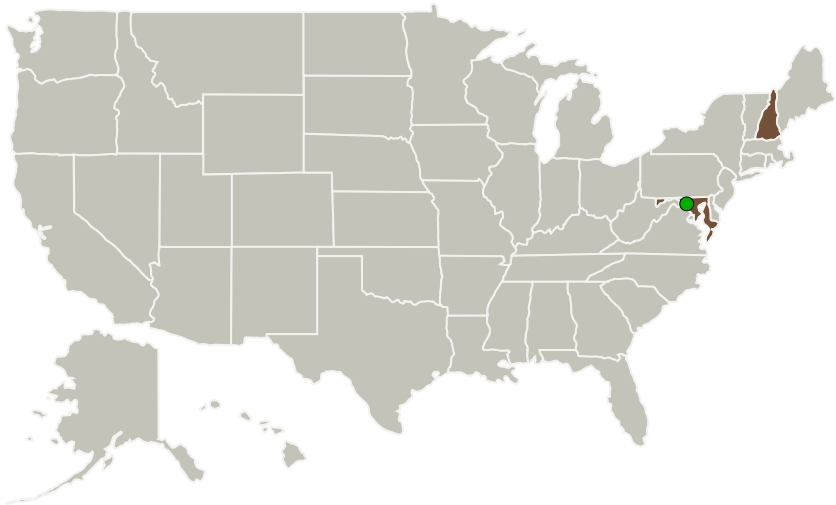
An Ultra Low Power Cryo-Refrigerator for Space, Phase I

Completed Technology Project (2011 - 2011)

Project Introduction

Future NASA Space Science Missions will incorporate detectors, sensors, shields, and telescopes that must be cooled to cryogenic temperatures. An enabling technology for these missions is advanced cryocoolers that can provide continuous and distributed cooling with minimal input power. On this program, Creare proposes to develop and demonstrate an innovative cryocooler that produces refrigeration at temperatures of 30 to 70 K and rejects heat at a temperature of 150 to 190 K with extremely high efficiency. The heat rejected can be absorbed by an upper stage cryocooler or rejected to space through a small cryo-radiator. The overall mass of the cryocooler and electronics is 3 kg, the size of the cryocooler is 6 liters, the area of the cryo-radiator is 0.5 square meters and the input power is significantly less than current state-of-the-art cryocoolers. In addition, the cryocooler technology is extremely reliable and scalable, and produces no perceptible vibration. The key innovation is a cryogenic compressor which has heritage to the cryogenic circulator developed by Creare and operated on the Hubble Space Telescope for 6.5 years. On the Phase I project, we will optimize the cryocooler design for a particular mission class and predict the performance of the cryocooler using component-level test data. On the Phase II project, we will build and test a brassboard cryocooler and cryo-radiator. The Phase II testing will be structured to achieve a TRL of 5, and will include testing with a cold-end temperature of 35 K and a heat rejection temperature of 150 K.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Creare LLC	Lead Organization	Industry	Hanover, New Hampshire
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
Maryland	New Hampshire

Project Transitions

February 2011: Project Start

September 2011: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140197)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Creare LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Mark Zagarola

Co-Investigator:

Mark Zagarola

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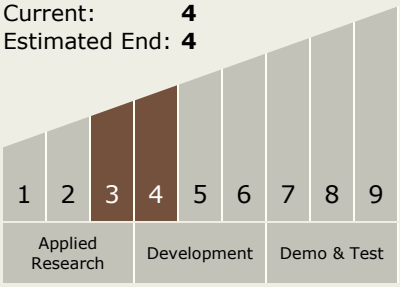
Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.1 Cryogenic Systems
    - TX14.1.3 Thermal Conditioning for Sensors, Instruments, and High Efficiency Electric Motors

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System